Ozone in the Tropical Tropopause Layer (TTL) over the Western Pacific

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The tropopause over the western tropical Pacific is one of the primary entry points of air from the troposphere into the stratosphere. Temperatures there are low enough in the TTL (~14-18.5 km) to dehydrate air to the low values observed in the stratosphere. The NASA Airborne Tropical Tropopause Experiment (ATTREX) mission included flights of the Global Hawk unmanned aircraft system (UAS) over the western tropical Pacific from Guam in January-March 2014 (ATTREX-3), with flights to the central and eastern tropical Pacific in previous years. During ATTREX-3, the Global Hawk was joined in Guam by the NSF/NCAR GV and British BAe-146 research aircraft on complementary missions, providing coverage of the atmosphere from the boundary layer to 19 km. Coincident balloon measurements of ozone and water vapor were also obtained for the February Global Hawk flights. The Global Hawk flew more than 100 vertical profiles in the TTL over the western tropical Pacific, as well as long sections at constant altitude. Ozone was consistently low (10-40 ppb) in the lower part of the TTL, with low values extending up to the thermal (cold point) tropopause, particularly in March 2014. While ozone as low as 20 ppb was occasionally observed over the central and eastern Pacific in February-March 2013 during ATTREX-2, it more often averaged 40-50 ppb, and typically increased slowly with height from about 14 km to the tropopause. In ATTREX-3, long-lived tracers such as N_2O were very close to their tropospheric values over the western tropical Pacific. Sulfur hexafluoride (SF_6) data suggested that sampled air masses had very recently originated at the surface, with negligible in-mixing of stratospheric air from midlatitudes. Methane and CO often peaked just below or near the local tropopause. These results indicate frequent deep convection, bringing air from the marine boundary layer (with low ozone and high values of long-lived trace species) directly to the upper troposphere. The origins and transport of air in the TTL during ATTREX-3 will be discussed, as well as the implications of the low ozone observed.